Patent claims

1. Procedure for increasing the filtrate volumetric flow rate during separation processes, which are accompanied by the formation of a filter cake, with use being made of at least one filter element, whereby pressure changes are imposed, before and/or during and/or after the separation process, on the filter element and/or the filter cake and/or the stream of filtrate flowing through the filter element with the filter cake.

2. Procedure for improving solid/liquid separation processes, which are accompanied by the formation of a filter cake, with use being made of at least one filter element, whereby pressure changes are imposed, before and/or during and/or after the separation process, on the filter element and/or the filter cake and/or the stream of filtrate flowing through the filter cake, and whereby these pressure changes lead to periodic loosening of the filter cover layer structures, which have formed, and hence to an increase in the filtrate volumetric flow rate.

3. Procedure in accordance with claim 1 or 2, characterized by the feature that the pressure changes are carried out in a pulsating manner.

4. Procedure in accordance with claim 1 or 2, characterized by the feature that the pressure changes are carried out periodically with a predetermined [harmonic] period.

5. Procedure in accordance with claim 1 or 2, characterized by the feature that the pressure changes, which are superimposed on the separation process, are carried out with a defined amplitude.

6. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that the pressure changes are carried out in a manner that is specific to the structure of the filter cake.

7. Procedure in accordance with claim 6, characterized by the feature that the pressure changes are carried out in accordance with empirical data.

8. Procedure in accordance with claim 7, characterized by the feature that the pressure changes, which are specific to the structure of the filter cake, are determined in the laboratory.

9. Procedure in accordance with claim 7 or 8, characterized by the feature that the pressure changes are carried out with optima, which are specific to the structure of the filter cake, or with at least one optimum.

10. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that, in regard to their intensity and/or amplitude and their duration, the pressure changes are implemented in accordance with a predetermined program, and preferably in a constant manner.

11. Procedure in accordance with claim 10, characterized by the feature that structure specific data are entered in the program, whereby these data are stored in a regulating unit that is provided with a computer.

12. Procedure in accordance with claim 1 and 2, characterized by the feature that the subjection of the separation process to stress via superimposed pressure changes takes place at a defined frequency, whereby this exceeds the minimum frequency that is established by the stress-specific structure realization time of the filter cake.

13. Procedure in accordance with claim 1, 2, or 3 characterized by the feature that the subjection of the filter cake to stress via pressure changes takes place only after having built up the filter cake and after having fallen short of the minimum filtrate flow rate.

14. Procedure in accordance with claim 1, 2, or 3 characterized by the feature that the subjection of the filter cake to stress takes place by means of pressure changes during the build up of the filter cake.

15. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that, jointly with the elimination of the particles in suspension, additionally added elastic auxiliary particles, which are compressible, are simultaneously eliminated and incorporated in the filter cake and, upon being subjected to pressure changes, these [auxiliary particles] lead to loosening of the filter cake structure and hence to an increase in filtrate permeability as a result of re-deformation, especially at the onset of the pressure reduction.

16. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that, as a result of the use of an elastically deformable and compressible filter medium (e.g. filter cloth), this filter medium is compressed under pressure upon being subjected to pressure changes, and it re-deforms upon removing the pressure, and it thus leads to periodic loosening of the filter cake that has formed on the filter medium, and hence it brings about an increase in filtrate volume.

17. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that the periodically imposed pressure changes take place with pressure imposition times and pressure relief times in the form of a ramp-type or rectangular function until the pressure plateau in question has been reached within a very short time, preferably within a few tenths of a second in accordance with the invention.

18. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that the phases of subjection to pressure and pressure relief are imposed periodically in accordance with a sinusoidal function.

19. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that the imposed pressure changes take place within different pressure ranges, i.e. the lower pressure plateau is minimally adjusted to atmospheric pressure and the upper pressure plateau is adjusted to maximally several hundred bar for applications using high pressure technology, e.g. applications in industrial pressure filters and hyperbaric centrifuges, and preferably to ≤ 5 bar.

20. Procedure in accordance with claim 1 or one of the claims subsequent thereto, characterized by the feature that, during the pressure changes, the lower pressure plateau within the negative pressure range is adjusted to ≥ 50 mbar, and the upper pressure plateau within the positive pressure range is adjusted to ≤ 20 bar, and preferably to ≤ 5 bar.

21. Device for carrying out the procedure according to the invention in accordance with claims 1 through 20, characterized by the feature that a filtration device is surrounded by a pressure resistant housing and that it is connected to a suspension stock supply container (4) via a pipeline, whereby pressure changes in the range between atmospheric pressure and an upper pressure plateau of ≤ 20 bar, and preferably ≤ 5 bar, are capable of being imposed pneumatically or hydrostatically over the suspension stock supply

container (4) or over the suspension pipeline (5) on the side where the suspension is located and out of sight of the filter medium, and/or pressure changes of ≤ 20 bar, and preferably ≤ 5 bar through 50 mbar (negative pressure) are capable of being imposed on the side where the filtrate is located and out of sight of the filter medium.

22. Device in accordance with claim 21, characterized by the feature that the stressing via subjection to pressure changes is capable of being produced on the side where the suspension is located either hydraulically or by imposing a gas pressure that varies periodically in a defined manner in terms of the amplitude of the pressure and the frequency of the pressure changes.

23. Device in accordance with claim 21, characterized by the feature that the stressing via subjection to pressure changes is capable of being produced on the side where the filtrate is located by imposing a defined periodic negative pressure.

24. Device in accordance with claim 21, characterized by the feature that the periodic subjection of the filter cake to pressure/negative pressure is achievable as a result of the imposition of positive pressure on the side where the suspension is located and as a result of the imposition of negative pressure on the side where the filtrate is located, or vice-versa, in time-shifted sequences.

25. Device in accordance with claim 21, characterized by the feature that a gas pressure tank is connected to the suspension stock supply container (4), whereby this tank allows gas, which is under pressure, to flow by means of a valve device into the suspension stock supply container (4) at defined intervals of time, and it allows a defined pressure to build up there with a temporal gradient that is defined in the same way.

26. Device in accordance with claim 21, characterized by the feature that a pressure relief valve (13) is connected to the gas head-space of the suspension stock supply container (4), whereby this valve can be opened in a defined manner at defined intervals of time, and it thus allows a defined decline in pressure to be produced with a temporal gradient that is defined in the same way.

27. Device in accordance with claim 21, characterized by the feature that pressure recorders (11, 12) for the measurement of local static pressures have been

incorporated in the suspension stock supply container (4) and, in the same way, in front of and behind the filter medium or the filter cake, respectively.

28. Device in accordance with claim 21, characterized by the feature that a microprocessor (14) has been adapted [appropriately] and is connected to the pressure recording sensors and the control valves in the form of actors, and the control valves (3, 13) can be actuated or, as the case may be, they can be set in a defined sequential order in such a way that pressure changes are capable of being adjusted in a defined manner in terms of their amplitude, frequency and temporal pressure profile as a function of, or independently of, the pressure difference that is measured over the height of the filter cake.

29. Device in accordance with claim 21, characterized by the feature that a mass-based flow meter is incorporated in the filtrate outlet of the filtration device and permanently determines the mass-based flow rate of the filtrate.

30. Device in accordance with claim 21, characterized by the feature that the mass-based flow meter for the filtrate is also connected to the microcomputer (14) and the amplitude, frequency, and temporal pressure profile of the pressure changes, which are imposed, are capable of being regulated by the microcomputer (14) as a function of the mass-based flow rate of the filtrate.